The state of knowledge regarding the properties of underground water may be said now to have become in advance of the ruling of the courts on some of the questions involved. The earlier legal decisions were made when little or nothing was known regarding the action of the water beneath the surface. Since then the progress of hydro-geological science has established as facts many things regarding underground waters previously unknown or only speculative, and the knowledge of the working of underground waters remains much less in the realms of the "secret, occult, and concealed." It has now become possible to define certain rights in these waters and to protect these rights equally as well as those in surface waters.

A case recently dealt with in one of the American State courts directs attention to the importance of emphasising the influence that the ever-increasing knowledge concerning underground waters may have in governing legal decisions. In an action brought in the State of Pennsylvania regarding the pollution of underground water, the judge remarked:—Geology has become a progressive and in many respects a practical science. More deep wells have been sunk in one State of America than had previously been dug in the entire earth in all time; and that which was formerly held to be unknown and merely speculative regarding the properties of underground water has been by experience reduced almost to a certainty. If it can be shown that the work done by the owner of the land would cause the inflow of salt water or oil to mingle with fresh water, and the means of preventing the mixing are available at a reasonable expense, then clearly it is a violation of the spirit of the law not to recognise the change, and to apply the settled principles of right to the altered conditions of fact.

In another case tried in California it was held that the usual rule of common law on the subject of percolation was not to be held as applying to an arid district that depended entirely for its cultivation on water derived from underground sources, and where the conditions were totally different from those existing in the locality where the rule in question was first established, and therefore an owner has no right to injure his neighbour's land by any unreasonable diversion of underground water by transferring the same for gain to another district.

PHYSICAL RESEARCH IN AMERICA.

TWO volumes, representing the first instalments of what is promised to be an annual publication, have been received from the physical laboratories of Harvard University.[1] Each contains fourteen papers contributed by the professors, staff, and students. In the preface the director, Prof. Trowbridge, acknowledges the great stimulus received by the establishment of the Thomas Jefferson Coolidge research fund, which has provided the laboratory with what the volumes show to be a very fine equipment, and has greatly increased the enthusiasm for physical research.

Most of the papers included are reprints from the *Proceedings of the American Academy* and the *Astrophysical Journal*. It is hardly possible to speak too highly of the handsome treatment they have received at the hands of the printer and binder, and especially of the manner in which the numerous plates have been reproduced. The range of subjects treated is a very wide one, and in a review of this kind it is not possible to deal with each paper individually.

In the first volume Prof. Trowbridge contributes an interesting paper on the spectra of gases and metals at high temperatures. He attempts to apply electrical stimulus of known amount to the gas in a vacuum tube by discharging through it a condenser of known capacity charged to a high potential by his powerful accumulator battery, by which he can obtain pressures up to 40,000 volts. He contrasts the relative intensities of the lines in the spectra thus obtained with the results got by other methods. When theorising on the relative volatility of metals it is desirable, however, to adopt more accurate data than some of those used in this paper, where "soft-iron" is said to melt "not far from 1100°," and aluminium "between 700° and 800°," instead of 657°.

Spectroscopy is evidently a favourite study in the laboratory, since five papers in each of the two volumes are devoted to it. Mr. Lyman gives an explanation of the "ghosts" and "false spectra" sometimes met with when using gratings, particularly in the extreme ultra-violet, and shows in a number of cases the relation between the wave-lengths of the various false lines and those of the parent lines to which they are due.

In another paper he discusses the various kinds of pro longations of spectral lines met with when using gratings, and shows them to be due to a cause quite different from Sir Norman Lockyer's "long and short lines."

Another interesting paper is by Mr. Morse on the spectra from the break in the Wehnelt interrupter, which appears to give spectra of a special character not classifiable under the division of "flame," "arc," "spark," or "enhanced spark."

Mr. B. O. Pierce contributes, in continuation of an earlier research, papers on thermal conductivity of rocks, one of which must have involved a long period of painstaking work. The apparatus employed was on a scale only possible where very considerable funds were available.

Prof. Hall has a paper on a theory of thermoelectric action, and, along with three other workers, one on thermal and electrical effects in "soft iron."

In several instances, work commenced in the laboratory appears to have been dropped on the publication of some paper slightly overlapping the research contemplated. It is a pity, for example, that the fine resistance bridge for platinum thermometry, described by Mr. Edwards, should not be used to solve some of the problems for which it is suited, and that the construction of a gas thermometer should not be proceeded with because of the publication during the past few years of several researches on gas thermometry.

Though none of the papers appear to be of epoch-making importance, the volumes show how a well equipped laboratory may contribute substantially to the advancement of knowledge. It would be interesting to see what effect the endowment of a representative physical laboratory in this country, with funds for research purposes, would have on the character of the work done, especially if at the same time it were possible to arrange that members of the teaching staff should have a more reasonable proportion of their time to devote to research work.

J. A. H.

[1] "Contributions from the Jefferson Physical Laboratory of Harvard University." (Cambridge, Mass., vol. i., 1903; vol. ii., 1904.)

FIREBALL OF JANUARY 27, 1906.

A MAGNIFICENT fireball was seen by many persons in the north of England on the evening of January 27 at 8h. 33m. Descriptions of its appearance have been received from Hull, Bramley, Bradford, Patrington, and other places in Yorkshire, from Sleaford and Billingborough in Lincolnshire, from Cheadle, Staffordshire, &c.

Mr. H. Beckwith, at Hull, observed the meteor travelling horizontally between the "square" of Ursa Major and the Belt of Orion, while at Cheadle, Miss Blagg noted the path as just above ζ Leonis. Mr. R. Felton, at Patrington, estimated the brightness of the object as quite equal to that of the full moon. It left a trail visible for some time afterwards; one observer says it remained for five minutes, two others estimate the duration as eight minutes, while at Billingborough a spectator watched it for more than ten minutes.

The meteor gave a very brilliant flash near its end point, and the suddenness of its apparition startled many people. Several of the observers were enabled to give the position of its flight with fair accuracy from the luminous trail it left behind.

The radiant point appears to have been near θ Boötis, or in $214°+53°$, and the height of the meteor was from about 59 to 45 miles over the North Sea immediately east of the Lincolnshire coast. The disappearance occurred at a point over "the Wash," about 6 miles S.S.E. from Wainfleet. The length of observed path was approximately

42 miles, and probable velocity of the object 24 miles per second.

The radiant point in the right hand of Boötes is very little known as a centre of meteoric divergence in the month of January. The only shower conformable with it was observed at Bristol in 1887–9 January 25–29, 213°+52°.

In recent years fireballs have been very numerous in this month, and especially at the epochs about January 9 to 13 and 24 to 29. They appear, however, to have belonged to a great many different systems, and have not supplied evidence of any rich individual display of bright meteors at this time of the year.

W. F. DENNING.

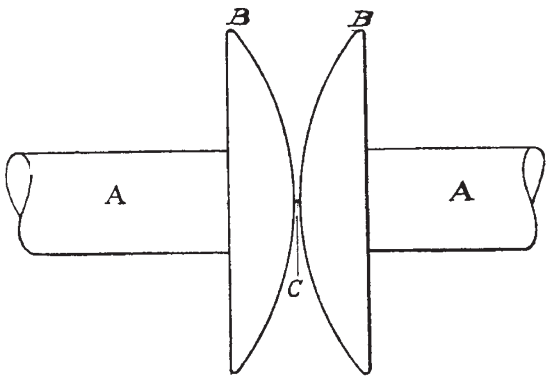
METHOD OF PRODUCING WAVES OF FREQUENCY INTERMEDIATE BETWEEN HEAT WAVES AND HERTZIAN WAVES.

THERE is at present a considerable gap of unexplored wave-lengths intermediate between those of Hertzian waves and what is commonly known as heat. The shortest Hertzian waves which have heretofore been produced are of the order of one millimetre length.

Some years ago the writer discovered a method of producing the heretofore unknown waves above referred to.

It is based on the phenomenon discovered by the writer and published by him in a paper on insulation and conduction read before the American Institute of Electrical Engineers in 1894.

In the accompanying figure, AA are copper rods, BB are plano-convex lenses. The distance between the surfaces of



the lenses depends upon the wave-length which it is desired to produce.

If BB were metallic terminals, the discharge passing at C would have a long wave-length on account of the capacity of BB. It is impossible to make metallic terminals small enough to get very short wave-lengths. But, in the apparatus shown in the sketch, if AA are connected to the terminals of a high-voltage machine sparks will be found to pass at C, and the oscillating conductor is merely the small column of incandescent gas, C.

If the distance between BB is very short, the wave-length will also be very short.

Waves may be produced in this method having a wave-length certainly not longer than a few ten-thousandths of an inch, and there would appear to be no necessary limit to the frequency. It sometimes happens that the discharge tends to pass at a point outside the axis, and hence to give a longer wave-length than desired, but this can be avoided by properly proportioning the curvature of the lenses and the diameter of the rods AA.

Inert gases of the helium type seem to give the best results, but very good results are obtained by using quartz lenses in air, the use of quartz having been suggested to me by Prof. Elihu Thomson. Quartz does not seem to become conducting on being heated by the passage of the discharge to anything like the same extent as glass, and hence the wave-length remains more constant.

Owing to pressure of other work, the writer has been unable to continue these experiments, but the apparatus would seem to be of interest as offering a means of obtaining waves of any desired high frequency.

REGINALD A. FESSENDEN.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The statement of the income and expenditure of the Common University Fund for 1905, published in last week's *Gazette*, shows that the income was 6806*l.* 9*s.* 8*d.*, to which the colleges contributed 6197*l.* 19*s.* 4*d.* under the statute concerning college contributions for university purposes, and the Royal Geographical Society 400*l.* towards the support of the department of geography. The total expenditure was 6260*l.* 14*s.* 11*d.*, of which sum 3662*l.* 19*s.* 5*d.* was devoted to scientific purposes, partly in the payment of the salaries of university readers and professors, and partly in assisting various laboratories and providing demonstrators and assistants.

At a meeting of the Junior Scientific Club, held at the Museum on February 23, Mr. M. H. Godby (Christ Church) read a paper on "The Place of Natural Science in Education."

CAMBRIDGE.—The Vice-Chancellor has been authorised to convey to Lord Rayleigh the grateful thanks of the University for his magnificent gift of 7733*l.* 12*s.* 8*d.*, being the amount of the Nobel prize awarded to him in 1904. Lord Rayleigh desires that 5000*l.* of this should be employed in erecting a new building in connection with the Cavendish Laboratory, and that the remainder should be devoted to the purchase of scientific books and periodicals for the University Library.

Sir George Darwin, K.C.B., Plumian professor of astronomy, will represent the University at the celebration of the 200th anniversary of the birth of Benjamin Franklin at Philadelphia in April.

The Special Board of Biology and Geology recommended that the agreement between the University and Dr. Dohrn, director of the Zoological Station at Naples, be renewed for a further period of five years by the payment to him of 100*l.* per annum out of the Worts travelling bachelors fund.

The General Board of Studies has nominated the following gentlemen as members of the Board of Electors to the professorships named below:—Dr. B. C. A. Windle, to the professorship of human anatomy; Prof. F. W. Oliver, to the professorship of botany; Lord Walsingham, to the professorship of zoology and comparative anatomy; Mr. J. Hutchinson, to the professorship of surgery; the Earl of Carrington, G.C.M.G., to the professorship of agriculture.

The following have been nominated examiners by the General Board of Studies for the special examination in agricultural science and for the diploma in agriculture:—Mr. J. B. Peace, Mr. H. Woods, Mr. T. B. Wood, Mr. R. H. Biffen, Prof. Middleton, Dr. Shore, Mr. T. A. Dickson, and Mr. A. E. Shipley.

At Gonville and Caius College the triennial Thruston prize of 54*l.*, open to a member of the college of not more than fifteen years' standing who has published in the course of the preceding three years the best original investigation in physiology, pathology, or practical medicine, has been awarded to Mr. W. S. Perrin, research student of the college. Mr. Perrin is an expert on protozoology, and has published papers on a so-called trypanosome in the oyster and on *Pleistophora periplanetae*.

LORD RAYLEIGH has promised to lay the foundation-stone of a new science school at Dulwich College on Saturday, March 3.

To the new buildings of the Sorbonne it has been decided to add a new university chemical laboratory, the Institut de Chimie, on a site between la rue Saint-Jacques and la rue d'Ulm, that is, in the neighbourhood of the Sorbonne.

PROF. R. J. HARVEY GIBSON writes from the Hartley Botanical Laboratories, University of Liverpool, to point